Course Structure

Chemistry

(A)Major Core Courses

Sl. No.	Sem.	Type of Course	Name of Course	Credits	Marks
1.	I	MJC-1 (T)	Inorganic Chemistry : Atomic Structure & Chemical Bonding Organic Chemistry : Fundamental of Organic Chemistry, stereochemistry & aliphatic hydrocarbons	4	100
		MJC-1 (P)	Inorganic Chemistry Lab: Volumetric analysis. Organic Chemistry Lab : Detection, Purification, Separation of organic Compouds.	2	100
2.	II	MJC-2 (T)	Physical Chemistry : States of matter and ionic equilibria.	4	100
		MJC-2 (P)	Physical Chemistry Lab: Determination of Physical Properties of liquids and pH- metry.	2	100
3.	III	MJC-3	Organic Chemistry : Basics and Hydrocarbons	5	100
4.	III	MJC-4 (T)	Physical Chemistry II: Chemical Thermodynamics and its Applications (T)	3	100
		MJC-4 (P)	Physical Chemistry II: Chemical Thermodynamics and its Applications (P)	1	100
5.	IV	MJC-5 (T)	Inorganic Chemistry II: s- and p Block Elements (T)	3	100
		MJC-5 (P)	Inorganic Chemistry II: s- and p Block Elements (P)	2	100
6.	IV	MJC-6 (T)	Organic Chemistry II: Oxygen Containing Functional Groups (T)	3	100
		MJC-6 (P)	Organic Chemistry II: Oxygen Containing Functional Groups (P)	2	100
7.	IV	MJC-7	Physical Chemistry III: Phase Equilibria and Electrochemical Cells	5	100
8.	V	MJC-8 (T)	Inorganic Chemistry III: Coordination Chemistry (T)	3	100
		MJC-8 (P)	Inorganic Chemistry III: Coordination Chemistry (P)	2	100
9.	V	MJC-9	Organic Chemistry III: Heterocyclic Chemistry	5	100
10.	VI	MJC-10 (T)	Physical Chemistry IV: Conductance & Chemical Kinetics (T)	3	100
		MJC-10 (P)	Physical Chemistry IV: Conductance & Chemical Kinetics (P)	1	100
11.	VI	MJC-11 (T)	Organic Chemistry IV: Biomolecules (T)	3	100
		MJC-11 (P)	Organic Chemistry IV: Biomolecules (P)	2	100
12.	VI	MJC-12	Physical Chemistry V: Quantum Chemistry & Spectroscopy	5	100
13.	VII	MJC-13	Inorganic Chemistry IV: Organometallic Chemistry	5	100
14.	VII	MJC-14	Research Methodology	5	100
15.	VII	MJC-15	Organic Chemistry V: Spectroscopy	6	100
16.	VIII	MJC-16	Analytical Methods in Chemistry (T)	4	100

Sub Total = 80

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Course Structure

Chemistry

(B) Minor Courses to be offered by the Department for students of other Departments of Science

Sl. No.	Sem	Type of Course	Name of Course	Credits	Marks
1.	I	MIC-1 (T)	Inorganic Chemistry : Atomic Structure & Chemical Bonding. Organic Chemistry : Fundamentals of Organic Chemistry, stereochemistry & aliphatic hydrocarbons.	2	100
		MIC-1 (P)	Inorganic Chemistry Lab : Volumetric analysis Organic Chemistry Lab : Detection, Purification & Separation of Organic Compounds.	1	100
2.	II	MIC-2 (T)	Physical Chemistry : States of Matter & Ionic Equilibrium	2	100
		MIC-2 (P)	Physical Chemistry Lab : Determination of S.T. Viscosity & Molecular weight.	1	100
3.	III	MIC-3	Organic Chemistry I: Basics and Hydrocarbons	3	100
4.	IV	MIC-4	Physical Chemistry II: Chemical Thermodynamics and its Applications	3	100
5.	V	MIC-5	Inorganic Chemistry II: s- and pBlock Elements	3	100
6.	V	MIC-6	Organic Chemistry II: Oxygen Containing Functional Groups	3	100
7.	VI	MIC-7	Physical Chemistry III: Phase Equilibria and Electrochemical Cells	3	100
8.	VI	MIC-8	Inorganic Chemistry III: Coordination Chemistry	3	100
9.	VII	MIC-9	Organic Chemistry III: Heterocyclic Chemistry	4	100
10.	VIII	MIC-10	Physical Chemistry IV: Conductance & Chemical Kinetics	4	100

Sub Total = 32

Note: The Department may reduce the syllabus of the Minor Courses as per the credit distribution. The Department concerned may also decide practical courses.

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Chemistry
SEMESTER – I
MJC-1(T) : Inorganic Chemistry: Atomic Structure, Chemical Bonding and fundamentals of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

Course Outcomes

After the completion of the course, the students will be able to understand the following:
: the model of an atom including the related various principles.
: the principles of bonding as well as shapes and structure of covalent molecules.
: Intial step of research in Organic Chemistry viz-Detectionl, Seperation and Purfication of Organic Compounds.

MJC-1(T)

(Theory: 4 credits)

Inorganic Chemistry : Atomic Structure and Chemical Bonding		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Atomic Structure :** Bohr's Theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrodinger's wave equation, significance of wave function. Quantum Numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusions Principle, Hund's Rule of maximum multiplicity, Aufbau's principle and its limitations, Variations of orbital energy with atomic number.	10
2	**Chemical Bonding:** (i) Ionic bond: General characteristics, types of ions size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Lande equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. (ii) Covalent bond: Lewis structure, Valence Bond Theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2,C_2, B_2, F_2 & CO, NO and their ions; hydrogen chloride, berrylium fluoride, carbon dioxide, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (sigma and pi bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polaizability. Fajan's rule and consequences of polarization. Ionic character in covalent compounds: Bond moment, dipole moment and electronegativity difference. (iii) Metallic bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. (iv) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen Bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.	10

Organic Chemistry:-Fundamentals, Sterochemistry and hydrocarbons.		
3	**Fundamentals of Organic Chemistry:** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules, Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.	05
4	**Stereochemistry** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).	05
5	**Aliphatic Hydrocarbons** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.	10
	TOTAL	40

Suggested Readings :

1. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
2. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
5. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
6. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.
7. Organic Chemisry - Graham Solomons
8. Sterochemistry – Conformation and Mechanism : P.S Kalsi
9. Organic Chemistry - Morrison & Boyd

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MJC -1 (P) : 2 Credits

Inorganic and Organic Chemistry Practical

Course Outcomes

After finishing this Practical Course, Studens will be skilled in-

1. Understanding and preparing solution of different strengths.
2. Calculating the neutral point in different titrations.
3. Initial research steps involved in Organic Chemistry.

Practical- 1. Inorganic Chemisry Practical

a. Acidimetry and Alkalimetry
b. Preparation and dilution of standard solutions.
c. Permangnatometry / dichromatry
d. Iodometry / iodimetry

Practical- 2.Organic Chemistry Practical

Detection of elements, separation and purification of Organic Compounds and Hydrolysis of ester.

Suggested Readings :

1. Practical inorganic chemistry : Shikha Gulati and J. L . Sharma
2. Practical Chemistry : Dr O .P. Pandey , D.N. Bajpayi & Giri.
3. Quantitative Chemical analaysis: A.I. Vogel, Prentice Hall Publication.
4. Text book of practical Organic Chemistry: A.I. Vogal, Prentice Hall Publication.
5. Practical Organic Chemistry, F.G. Mann & B.C. Saunders,Orient long man.

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Chemistry

SEMESTER – II

MJC-2(T) : Physical Chemistry: States of matter and Ionic Equilibrium

Course Outcomes

After the completion of this course, the student will have sound knowledge and understanding about:

: The mathematical expressions for different Properties of gas, liquid and solid and understand their physical significance.

: The Crystal structure, and may calculate related properties of different crystal systems.

: The concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.

: The concepts of pH, pK_a, pK_b, pK_w Buffer Solutions, Solubility Product etc. and their applications in day to daylife.

MJC-2(T)

(Theory: 4 credits)

Physical Chemistry : States of matter and Ionic Equilibrium		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Gaseous state:** Kinetic molecular model of a gas postulates and concept of an Ideal gas, Derivation of the kinetic gas equation and various gas laws; Maxwell's Distribution of Molecular velocities and its use in evaluating different types of molecular velocities – Most Probable Velocity, Average (Mean) Velocity, Root Mean Square (RMS) Velocity, and Average kinetic energy; Relationship between various molecular velocities; Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Viscosity of gases, co-efficient of viscosity and its dependence on temperature and pressure; Collision frequency, Collision diameter and Mean free path; Relationship between mean free path (λ) and co-efficient of viscosity (η), Calculation of collision diameter (σ) from co-efficient of viscosity (η). Behaviour of real gases: Deviations form ideal gas behavior, compressibility factor Z, and its variation with pressure for different gases; Causes of deviation from ideal behaviour. Equation of states for real gases; Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature; Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state & critical constants, relation between critical constants and van der Waals constants, law of corresponding states.	12
2	**Liquid state:** Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.	08
3	**Solid state:** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravaislattices;x-ray diffraction, Bragg'slaw, a simple account of rotating crystal method and powder pattern method; Analysis of powder diffraction patterns of NaCl, CsCl and KCl.	08

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4	**Ionic equilibria**: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases,dissociation constants of mono and diprotic acids; pH and pOH, pH scale; common ion effect; Salt hydrolysis, calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Bufffer solutions; derivation of Henderson equation and its applications; Solubility product of sparingly soluble salts, applications of solubility product principle; Qualitative treatment of acid- base titration curves (calculation of pH at various stages). Theory of acid-base indicators; selection of indicators and their limitations.	12
	TOTAL	40

Suggested Readings :

1. Atkins, P.W.; Paula, J.de.; Atkin's Physical Chemistry; Oxford UniversityPress.
2. Ball, D.W.; Physical Chemistry; Cengage Learning,India.
3. Castellan, G.W; Physical Chemistry;Narosa.
4. Kapoor, K.L.; A Textbook of Physical Chemistry, Vol 1, 6Th Edition; McGraw Hill Education.
5. Puri, Sharma, Pathania; Principles of Physical Chemistry; Vishal PublishingCo.
6. Pahari, S.; Physical Chemistry Vol I & II; New Central Book Agency (P)Ltd.
7. Moore, W.J.; Physical Chemistry, 5th Edition, Longmans Green & Co.Ltd.
8. Glasstone, S.; Textbook of Physical Chemistry; D. Van Nostrand company, New York.

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MJC-2(P): Physical Chemistry Lab

Course Outcomes

When the students will finish this practical course , they will be skilled in :-

:determination of coefficient of viscosity of various types of solutions and also in the determination of the surface tension of the various type of liquids.

:molecular weight determination by victor mayer method.

: preparation of buffer solution, pH determination of various types of buffer solutions.

MJC-2(P) :Physical Chemistry **(Practical: 2 credits)**
Practical : **Surface tension measurements using Stalagmometer** Determine the surface tension of aqueous solutions by (a) drop number, (b) drop weight method. **Viscosity measurementusing Ostwald's viscometer.** 1. Determination of co-efficient of viscosity of an unknown aqueous solution. 2. Study of variation of viscosity with different concentration of sugar solutions. **Molecular weight of a volatile compound** Determination of molecular weight of a volatile compound using Victor Meyer's method. **pH- metry:** 1. Study the effect of addition of HCl/ NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures. 2. Preparation of buffer solutions of different pH values (a) Sodium acetate- acetic acid (b) Ammonium chloride-ammonium hydroxide 3. pH metric titration of (a) strong acid with strong base, (b) weak acid with strong base and determination of dissociation constant of a weak acid.

Suggested Readings :

1. Khosla, B.D.; Garg, V.C. & Gulati, A.; Senior Practical Physical Chemistry; R. Chand & Co, NewDelhi.
2. Garland, C.W.; Nibler, J.W.; Shoemaker, D.P.; Experiments in physicalChemistry, 8th Edition, McGraw-Hill, New York.
3. Yadav, J. B.; Advanced Practical Physical Chemistry, 32nd Ed; Goel Publishing House.

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SEMESTER – I

MIC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding and Fundamentals of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MIC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding (Theory: 2 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Atomic Structure:** *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.* Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configuration, Hund's, Pauli's and Aufbau's principle.	06
2	**Chemical Bonding and Molecular Structure** *Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. *Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.	06
	***Section B: Organic Chemistry-1* (30 Periods)**	
3	**Fundamentals of Organic Chemistry** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.	04
4	**Stereochemistry** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).	04
	TOTAL	20

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Suggested Readings :

1. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
2. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
5. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
6. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.

Reference Books:

7. □ J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
8. □ F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
9. □ Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*,
10. John Wiley.
11. □ James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles*
12. *of Structure and Reactivity*, Pearson Publication.
13. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
14. □ Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
15. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
16. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
17. □ R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
18. □ Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

MIC-1(P): Inorganic and Organic Chemistry Lab

(Practical : 1 Credit)

Practical- 1. Inorganic Chemisry Practical

a. Preparation and standardization of solutions.
b. Permangnatometry / dichromatry.
c. Acidimetry / Alkalimetry.

Practical- 2. Organic Chemisry Practical

Organic Practical : Detection of elements, separation and purification of Organic Compounds.

Suggested Readings :

1. Practical inorganic chemistry : Shikha Gulati and J. L . Sharma
2. Practical Chemistry : Dr O .P. Pandey , D.N. Bajpayi& ,Giri.
3. Quantitative Chemical analaysis: A.I. Vogel, Prentice Hall Publication.
4. Text book of practical Organic Chemistry: A.I. Vogal, Prentice Hall Publication.
5. Practical Organic Chemistry, F.G. Mann & B.C. Saunders,Orient long man.

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SEMESTER – II

MIC-2 (T) : Inorganic Chemistry Atomic Structure, Chemical Bonding and Fundamental of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MIC-2 : Inorganic Chemistry I Atomic Structure and Chemical Bonding

(Theory: 2 credits)

Unit	Topics to be covered	No. of Lectures
1	**Atomic Structure:** What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ_2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.	04
2	**Chemical Bonding and Molecular Structure** MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	04
	Organic Chemistry	
3	**Aliphatic Hydrocarbons** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *Preparation-* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$	06

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4	**Gaseous state:** Kinetic molecular model of a gas postulates and concept of an Ideal gas, Derivation of the kinetic gas equation and various gas laws; Maxwell's Distribution of Molecular velocities and its use in evaluating different types of molecular velocities – Most Probable Velocity, Average (Mean) Velocity, Root Mean Square (RMS) Velocity, and Average kinetic energy; Relationship between various molecular velocities; Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Viscosity of gases, co-efficient of viscosity and its dependence on temperature and pressure; Collision frequency, Collision diameter and Mean free path; Relationship between mean free path (λ) and co-efficient of viscosity (η), Calculation of collision diameter (σ) from co-efficient of viscosity (η). Behaviour of real gases: Deviations form ideal gas behavior, compressibility factor Z, and its variation with pressure for different gases; Causes of deviation from ideal behaviour. Equation of states for real gases; Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature; Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state & critical constants, relation between critical constants and van der Waals constants, law of corresponding states.	06
	TOTAL	20

Suggested Readings :

1. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
2. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
5. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
6. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.

Reference Books:

7. □ J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
8. □ F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
9. □ Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*,
10. John Wiley.
11. □ James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles*
12. *of Structure and Reactivity*, Pearson Publication.
13. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
14. □ Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
15. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
16. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
17. □ R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
18. □ Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

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MIC-2(P): Physical Chemistry Lab.

When the students will finish this practical course , they will be skilled in:-

- **: determination of coefficient of viscosity of various types of liquids and also in the determination of the surface tension of the various types of liquids.**
- **: molecular weight determination by victor Meyer Method.**
- **: pH dermination of various types of buffer solutions.**

MIC-2(P) :Physical Chemistry Lab.

(Practical: 1 credit)

Practical :

Surface tension measurements using Stalagmometer

Determine the surface tension of aqueous solutions by (a) drop number, (b) drop weight method.

Viscosity measurement using Ostwald's viscometer.

1. Determination of co-efficient of viscosity of an unknown aqueous solution.
2. Study of variation of viscosity with different concentration of sugar solutions.

Molecular weight of a volatile compound

Determination of molecular weight of a volatile compound using Victor Meyer's method.

Suggested Readings :

1. Khosla, B.D.; Garg, V.C. & Gulati, A.; Senior Practical Physical Chemistry; R. Chand & Co, NewDelhi.
2. Garland, C.W.; Nibler, J.W.; Shoemaker, D.P.; Experiments in physicalChemistry, 8th Edition, McGraw-Hill, New York.
3. Yadav, J. B.; Advanced Practical Physical Chemistry, 32nd Ed; Goel Publishing House.

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SEMESTER – I

MDC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding and Fundamentals of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MDC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding (Theory: 2 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Atomic Structure:** *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.* Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configuration, Hund's, Pauli's and Aufbau's principle.	06
2	**Chemical Bonding and Molecular Structure** *Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. *Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.	06
	Section B: Organic Chemistry-1	
3	**Fundamentals of Organic Chemistry** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.	04
4	**Stereochemistry** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).	04
	TOTAL	20

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Suggested Readings :

19. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
20. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
21. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
22. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
23. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
24. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.

Reference Books:

25. □ J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
26. □ F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
27. □ Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*,
28. John Wiley.
29. □ James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles*
30. *of Structure and Reactivity*, Pearson Publication.
31. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
32. □ Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
33. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
34. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
35. □ R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
36. □ Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

MDC-1(P): Inorganic and Organic Chemistry Lab

(Practical : 1 Credit)

Practical- 1. Inorganic Chemisry Practical

b. Preparation and standardization of solutions.
d. Permangnatometry / dichromatry.
e. Acidimetry / Alkalimetry.

Practical- 2. Organic Chemisry Practical

Organic Practical : Detection of elements, separation and purification of Organic Compounds.

Suggested Readings :

6. Practical inorganic chemistry : Shikha Gulati and J. L . Sharma
7. Practical Chemistry : Dr O .P. Pandey , D.N. Bajpayi& ,Giri.
8. Quantitative Chemical analaysis: A.I. Vogel, Prentice Hall Publication.
9. Text book of practical Organic Chemistry: A.I. Vogal, Prentice Hall Publication.
10. Practical Organic Chemistry, F.G. Mann & B.C. Saunders,Orient long man.

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SEMESTER – II

MDC-2 (T) : Inorganic Chemistry: Atomic Structure, Chemical Bonding and Fundamental of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MDC-2 : Inorganic Chemistry I Atomic Structure and Chemical Bonding

(Theory: 2 credits)

Unit	Topics to be covered	No. of Lectures
1	**Atomic Structure:** What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ_2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.	04
2	**Chemical Bonding and Molecular Structure** MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	04
	Organic Chemistry	
3	**Aliphatic Hydrocarbons** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *Preparation-* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.	06

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4	**Gaseous state:** Kinetic molecular model of a gas postulates and concept of an Ideal gas, Derivation of the kinetic gas equation and various gas laws; Maxwell's Distribution of Molecular velocities and its use in evaluating different types of molecular velocities – Most Probable Velocity, Average (Mean) Velocity, Root Mean Square (RMS) Velocity, and Average kinetic energy; Relationship between various molecular velocities; Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Viscosity of gases, co-efficient of viscosity and its dependence on temperature and pressure; Collision frequency, Collision diameter and Mean free path; Relationship between mean free path (λ) and co-efficient of viscosity (η), Calculation of collision diameter (σ) from co-efficient of viscosity (η). Behaviour of real gases: Deviations form ideal gas behavior, compressibility factor Z, and its variation with pressure for different gases; Causes of deviation from ideal behaviour. Equation of states for real gases; Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature; Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state & critical constants, relation between critical constants and van der Waals constants, law of corresponding states.	06
	TOTAL	20

Suggested Readings :

19. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
20. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
21. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
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31. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
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33. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
34. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
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MDC-2(P): Physical Chemistry Lab.

When the students will finish this practical course , they will be skilled in:-

- **: determination of coefficient of viscosity of various types of liquids and also in the determination of the surface tension of the various types of liquids.**
- **: molecular weight determination by victor Meyer Method.**
- **: pH dermination of various types of buffer solutions.**

MDC-2(P) :Physical Chemistry Lab.

(Practical: 1 credit)

Practical :

Surface tension measurements using Stalagmometer

Determine the surface tension of aqueous solutions by (a) drop number, (b) drop weight method.

Viscosity measurement using Ostwald's viscometer.

3. Determination of co-efficient of viscosity of an unknown aqueous solution.
4. Study of variation of viscosity with different concentration of sugar solutions.

Molecular weight of a volatile compound

Determination of molecular weight of a volatile compound using Victor Meyer's method.

Suggested Readings :

4. Khosla, B.D.; Garg, V.C. & Gulati, A.; Senior Practical Physical Chemistry; R. Chand & Co, NewDelhi.
5. Garland, C.W.; Nibler, J.W.; Shoemaker, D.P.; Experiments in physicalChemistry, 8th Edition, McGraw-Hill, New York.
6. Yadav, J. B.; Advanced Practical Physical Chemistry, 32nd Ed; Goel Publishing House.

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CHEMISTRY

The Question paper pattern of B.SC for 1st and 2nd Semester of 4 Year Course under CBCS.

The question papers ESE shall be set as per following pattern:-

Semester-I

Course	CIA	ESE	Total Marks
MJC-1 (T)	30	70	100
MJC-1 (P)	30	70	100
MIC-1 (T)	30	70	100
MIC-1 (P)	30	70	100
MDC-1 (T)	30	70	100
MDC-1 (P)	30	70	100
Semester-II			
MJC-2 (T)	30	70	100
MJC-2 (P)	30	70	100
MIC-2 (T)	30	70	100
MIC-2 (P)	30	70	100
MDC-2 (T)	30	70	100
MDC-2 (P)	30	70	100

The marks distribution for ESE of theory paper carrying 70 marks will consist of three parts :-

Part –(A) – Compulsory- consisting of Ten objective / multiple choice questions each carrying two marks.

(10x2=20 marks)

Part –(B) – Short answer type- Four questions to be answered out of six questions carrying five marks each.

(04x05=20 marks)

Part –(B) – Long answer type- Three questions to be answered out of five questions carrying ten marks each.

(03x10=30 marks)

Total = 70 Marks

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